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SHIP TO SHORE OREGON TEST SERIES II PRELIMINARY REPORT

H. E. Reed

RCA Corporation

Prepared for:

Air Force Eastern Test Range
Defense Advanced Research Projects Agency

20 April 1973

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This preliminary report presents the results of the Oregon Test Series II conducted at Culp Creek, Oregon, during the week of 12 - 16 March 1973, by the Range Measurements Laboratory in support of the Ship to Shore Program. The final report is planned to be published 18 May 1973. Contributions to this report by the following personnel are acknowledged:

Battelle Memorial Institute - Dr. C. Dudley Fitz
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Naval Civil Engineering Laboratory - Mr. Mike Wolfe

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SHIP TO SHORE

OREGON TEST SERIES II

PRELIMINARY REPORT

20 APRIL 1973

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TABLE OF CONTENTS

SECTION		PAGE NO.
	Distribution	i
	Abstract	ii
I	SUMMARY	1
II	INTRODUCTION	1
III	OBJECTIVES	2
IV	TEST OPERATIONS	6
V	TEST RESULTS	18
VI	CONCLUSIONS	19
APPENDIX I -	Detailed Test Results	a1

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A B S T R A C T

This preliminary report presents the results of the Oregon Test Series II conducted at Culp Creek, Oregon, during the week of 12 - 16 March 1973, by the Range Measurements Laboratory in support of the Ship to Shore Program. The final report is planned to be published 18 May 1973.

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I SUMMARY

The Oregon Test Series II operations were conducted during the week of 12-16 March 1973. The purpose of the tests was to evaluate the feasibility of utilizing a natural shape balloon logging system in a Ship to Shore cargo transport configuration and to obtain container transport times and velocities, container positioning accuracies and the forces associated with the cable system.

Standard MILVAN containers were inserted and extracted from a Simulated Containship cell even with greater than 10% off center loading of the MILVAN and with 5° pitch/roll of the cell. The average cycle time to transport a MILVAN from the simulated cell 1500 feet to shore and return was less than six minutes. It is believed that increased personnel proficiency and system optimization could reduce this cycle time significantly

The tests results indicate substantial potential for the Balloon Transport System in a Ship to Shore transport mode. This system could be used for Ship to Shore transport as an aerial tramway, ship to lighterage as an extension of the ships gear, and lighterage to shore movement.

II INTRODUCTION

The Oregon Test Series II, the second series of tests in support of the Balloon Ship to Shore Transport Program, was conducted by the Range Measurements Laboratory during the week of 12 - 16 March 1973 at Culp Creek, Oregon, utilizing an existing balloon logging system and operating crew under contract with Raven Industries, Inc., and subcontracted to the Bohemia Lumber Company. The balloon used has a volume of 530,000 ft^3 with a net lift at sea level of 24,000 pounds. Standard MILVAN containers and a spreader bar connection system were used in this test series. In addition, the sling connection system was examined.

These tests were a follow-on to the Oregon Test Series I conducted in the same general area on 13 and 14 October 1972 at which time an operational balloon logging system was utilized to handle and transport 20' MILVAN and 40' containers.

The Oregon Test Series II test site was located adjacent to the area where the balloon was bedded down for the Oregon winter. Weather was generally rainy with temperatures ranging in the 40° area. Operations were hampered by the adverse weather and muddy condition, however, all major objectives were met with additional tests conducted at the request of the Army and Navy observers.

Original Ship to Shore test plans were to conduct an over-water demonstration at Cape Kennedy Air Force Station, however, this was prohibited by the unavailability of the NASA barge at the required time. Subsequent ARPA fund limitations prohibited shipping the necessary equipment to Cape Kennedy. Because of these funding limitations, the tests were arranged to be conducted in Oregon simulating as nearly as possible a Ship to Shore cargo transport scenario.

III OBJECTIVES

The general objective of this test series was to obtain field measurements of the performance characteristics and dynamic conditions of a simulated balloon ship to shore transport system. These measurements will be used in evaluating the feasibility of utilizing balloon transport for the off-shore discharge of container ships.

A. The first portion of the Series II field tests was directed toward examining the operational performance of the balloon transport system in three primary transport scenarios and additional tests described as follows:

1. Scenario S-1. Using a spreader bar attachment device, extract a container from a container cell, transport the container a distance of at least 1500 ft and deposit in a general area with an accuracy of ± 10 ft (simulates transport from ship to shore with broad placement latitude on beach).

2. Scenario S-2. Extract a container as in Scenario S-1, transport a distance of at least 1500 ft and deposit with relative accuracy of ± 1.5 ft (simulates transport from ship to shore with deposit on a hopper using voice radio for control during final placement).

3. Scenario S-3. Extract a container as in Scenarios S-1 and S-2, transport a distance of approximately 200 ft and deposit with relative accuracy of ± 1 ft (simulates transport to lighterage with visual control during final placement).

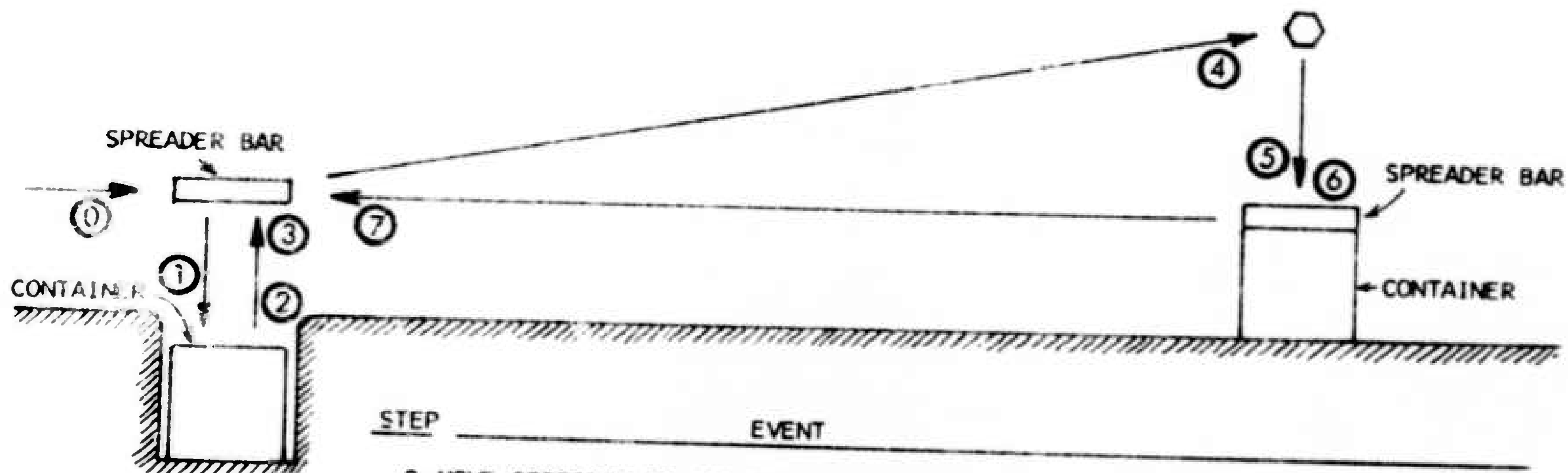
4. Additional Tests: Performed to examine the feasibility of loading/off loading a ship with the yarder on the shore. The simulated ships cell was placed in the general landing area 1500' from the yarder. The capability of inserting/extracting the container into/from a ship's cell 1500' from the yarder was tested. The container was not visible to the yarder operator, however, voice communications proved adequate to aid the yarder operator in accomplishing the insertion/extraction.

B. Several specific test objectives were accomplished while performing these scenarios:

1. Test Objective A - Performance Time

The total cycle time and the incremental time for each operational step were measured for each of the three scenarios. A diagram of each step of the cycle is depicted in Figure 1. These steps are as follows:

BREAKDOWN OF CYCLE



STEP	EVENT
0.	MOVE SPREADER TO BAR FROM ARBITRARY START POINT TO POSITION OVER SELECTED CELL
1.	INSERT SPREADER BAR INTO CELL
2.	ATTACH SPREADER BAR TO CONTAINER
3.	EXTRACT CONTAINER FROM CELL
4.	MOVE CONTAINER TO DEPOSIT POINT
5.	DEPOSIT CONTAINER
6.	DISSCONNECT SPREADER BAR
7.	RETURN TO SELECTED CELL FOR NEXT CONTAINER

Figure 1

0. Move spreader bar from arbitrary start point to position over selected cell.

1. Insertion of the spreader bar into the cell.
2. Attachment of the spreader bar.
3. Extraction of the container.
4. Movement of the container to the deposit point.
5. Deposit container.
6. Disconnect spreader bar.
7. Return to starting point over cell.

2. Test Objective B - Rigging Configuration

The merits of the conventional yarding system, Figure 8, the skyline system, Figure 9, and the Flying Dutchman, Figure 6, were evaluated.

3. Test Objective C - Force Measurement

Forces present on the cable system including the balloon line, load line, main line, haulback line and the Flying Dutchman were measured as follows:

a. Through several complete cycles of the three scenarios with the simulated cell in a level position.

b. During the extraction of a loaded container from a container cell which has been tilted in the fore and aft directions through a 5° angle simulating roll and pitch of a ship.

c. During the extraction from a tilted cell a loaded container whose CG has been displaced from the center point by 10%.

The force measurements for extraction conditions b and c were not accomplished concurrent with the operational performance measurements. This force measurement data was measured with a load cell in the load line and transmitted via hard wire to the instrumentation van.

IV TEST EQUIPMENT AND CONFIGURATION DESCRIPTION

A. General

The tests were accomplished on a site near Culp Creek, Oregon, utilizing a standard heavy lift balloon logging system owned and operated by Balloon Trans-Air, a subsidiary of Bohemia Lumber Company. Major components of the balloon logging system consisted of a Model 530K balloon and a Model 608A Yarding Winch. Standard MILVAN containers and spreader bar furnished by the U. S. Army were used in addition to a simulated container ship's cell fabricated in accordance with drawings from the Report of Operations and Evaluation of Offshore Discharge of a Container Ship dated 6 January 1971, published by Hunter's Point Naval Shipyard.

The site, designed to simulate a ship to shore movement, was laid out on a reasonably level area of ground and provided a transport distance of approximately 1500 feet. Two different cable configurations were evaluated - the conventional and skyline systems.

A description of the major items of equipment and the test site configuration is presented in the following paragraphs.

Equipment Description

1. Balloon

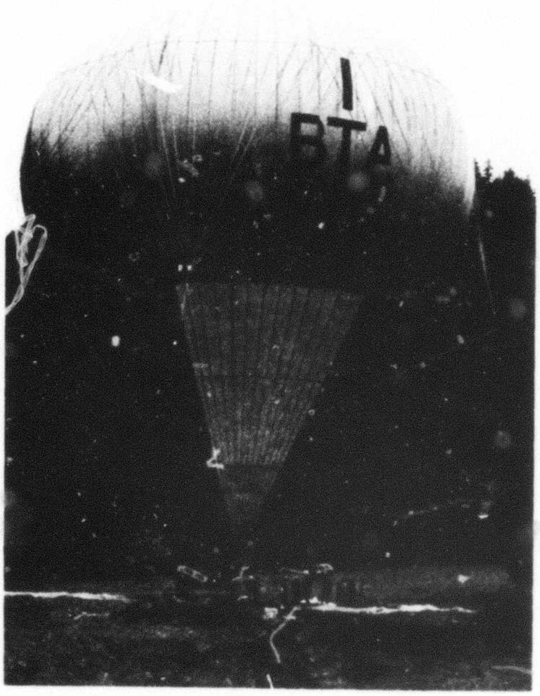


Figure 2 Natural Shape Balloon

The balloon shown in Figure 2 is a Model 530K manufactured by Raven Industries, Inc., Sioux Falls, S. D., and has a maximum volume of 530,000 cubic feet. It is fabricated from a urethane coated polyester fabric, weighs approximately 6,000 pounds, and is operated at approximately 90% inflated condition to allow for gas volume variations caused by temperature and altitude variations.

2. Yarding Winch

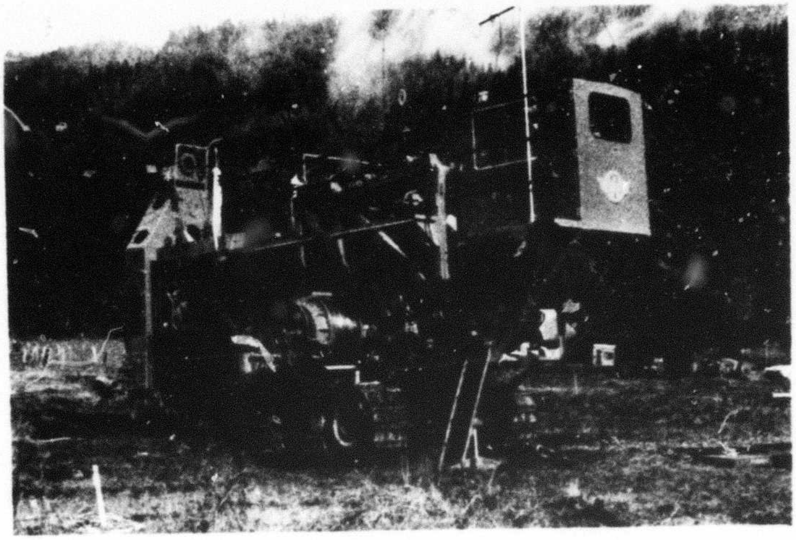


Figure 3 Yarding Winch

The winch shown in Figure 3, Model 608A manufactured by Washington Iron Works of Seattle, Washington, is equipped with two drums and is powered by a 500 HP Detroit Diesel Engine. The mainline drum has a capacity of 3,000 feet of one inch steel cable and the haulback drum a capacity of 7,000 feet of one inch steel cable. Maximum cable speeds are 1,600 ft/min for the mainline which controls the balloon directly from the winch and 2,100 ft/min for the haulback line, which is routed through several blocks to the balloon to provide movement toward the landing site.

3. Container Cell

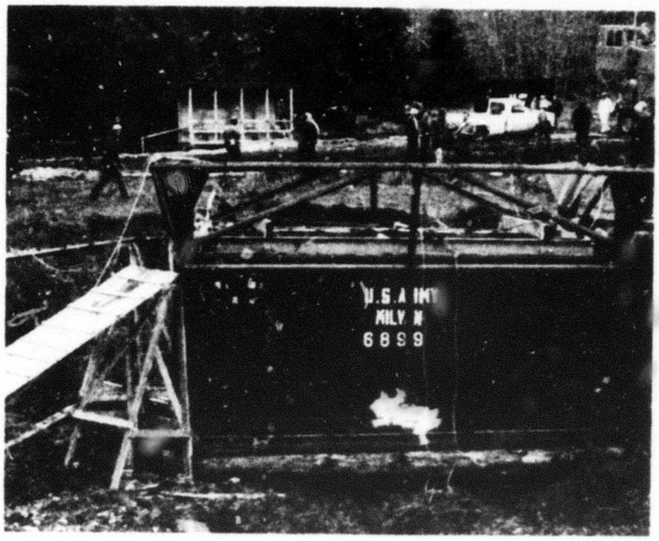


Figure 4 Simulated Ship's Cell Containing MILVAN

The simulated container cell shown in Figure 4 was fabricated from six inch steel angle iron and was sized to provide 3/4 inch clearance between the container and vertical guides in both directions in each corner. Flared guides, similar to a standard ship container cell configuration, were provided in each corner. The cell would fully accommodate one container with 2-1/2 feet in height below the flares to spare. This extra height was provided to test for binding during extraction and insertion of the MILVAN. In addition, a second MILVAN could be stacked on the first.

4. Container

The containers utilized were standard Army twenty foot MILVAN containers. Four of the containers were made available by the DOD Project Manager, Surface Container Distribution System for the testing.

5. Spreader Bar

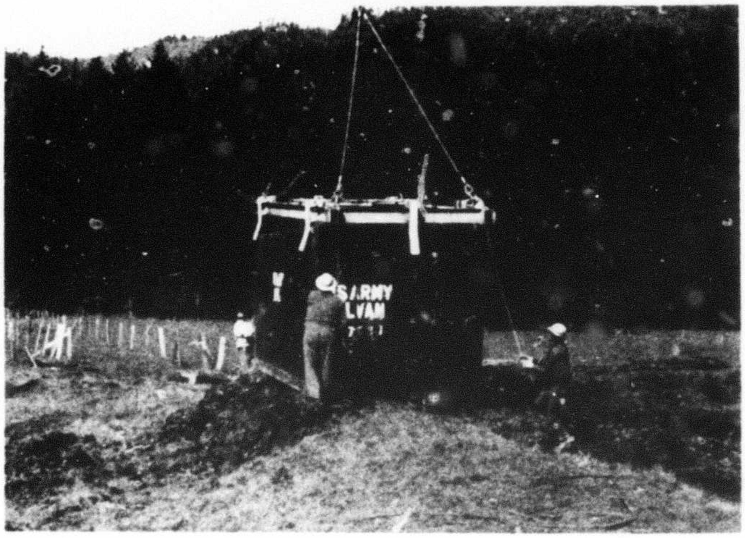


Figure 5 Spreader Bar Attachment to MILVAN

A standard manually operated spreader bar shown in Figure 5, was utilized in the tests. As received, five of six integral spreader bar guides were missing. New guides were fabricated and installed to replace the missing ones. These guides were lowered when picking up a container on the deck and raised when inserting or extracting a container from the cell.

6. Flying Dutchman

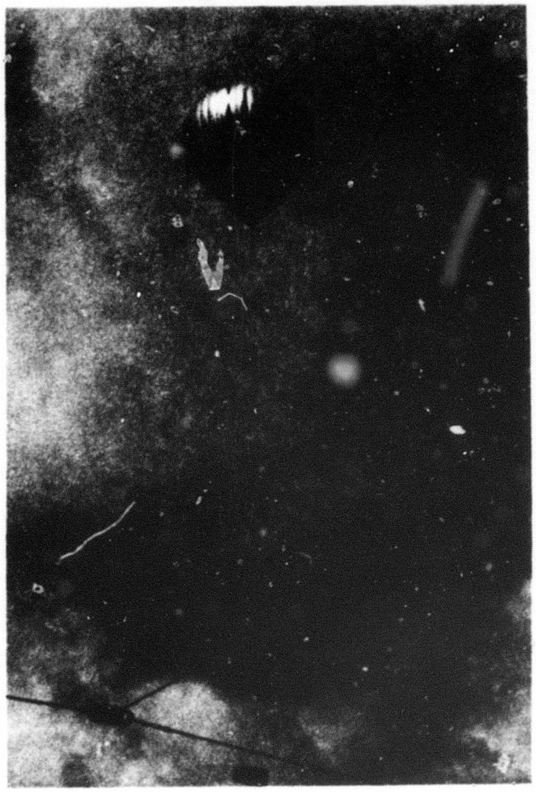


Figure 6 Flying Dutchman Rigging Attachment to the Main Line

The Flying Dutchman rigging consists of a running block installed on the mainline cable of the yarding winch, and connected by a length of cable to a D-8 caterpillar. This rigging system was used by moving the caterpillar to deflect the mainline and thus provide a lateral positioning capability of the balloon/yarder cable configuration. This configuration can be utilized at the pick up and/or discharge point of the operation. The same displacement could be accomplished by utilizing a winch fixed to the deck of a support boat or the cargo ship.

7. Instrumentation

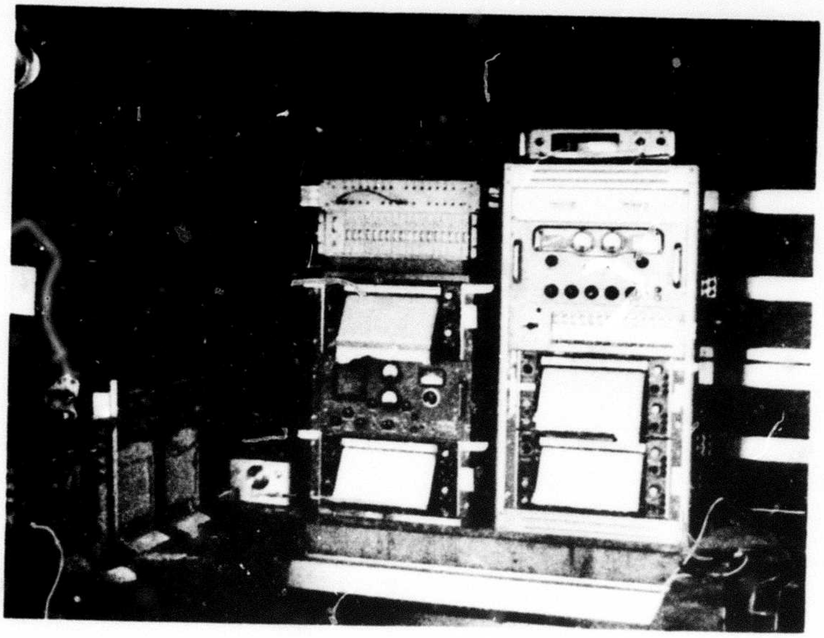


Figure 7 Ground Instrumentation Station

Instrumentation was incorporated in the test to provide means of measuring and recording a variety of parameters. The two basic methods utilized were sensors hard wired to recorders and sensors in which the data was telemetered to a ground receiving station. This station was assembled in a MILVAN utilizing RML/TELTA, Raven Industries, and Washington Iron Works equipment to acquire and record the data.

Washington Iron Works, Seattle, Washington, provided instrumentation to measure and record the yarder's main and haulback cables tension and speed. This instrumentation, located on the yarder and wired directly to recorders, provided continuous monitoring of these parameters.

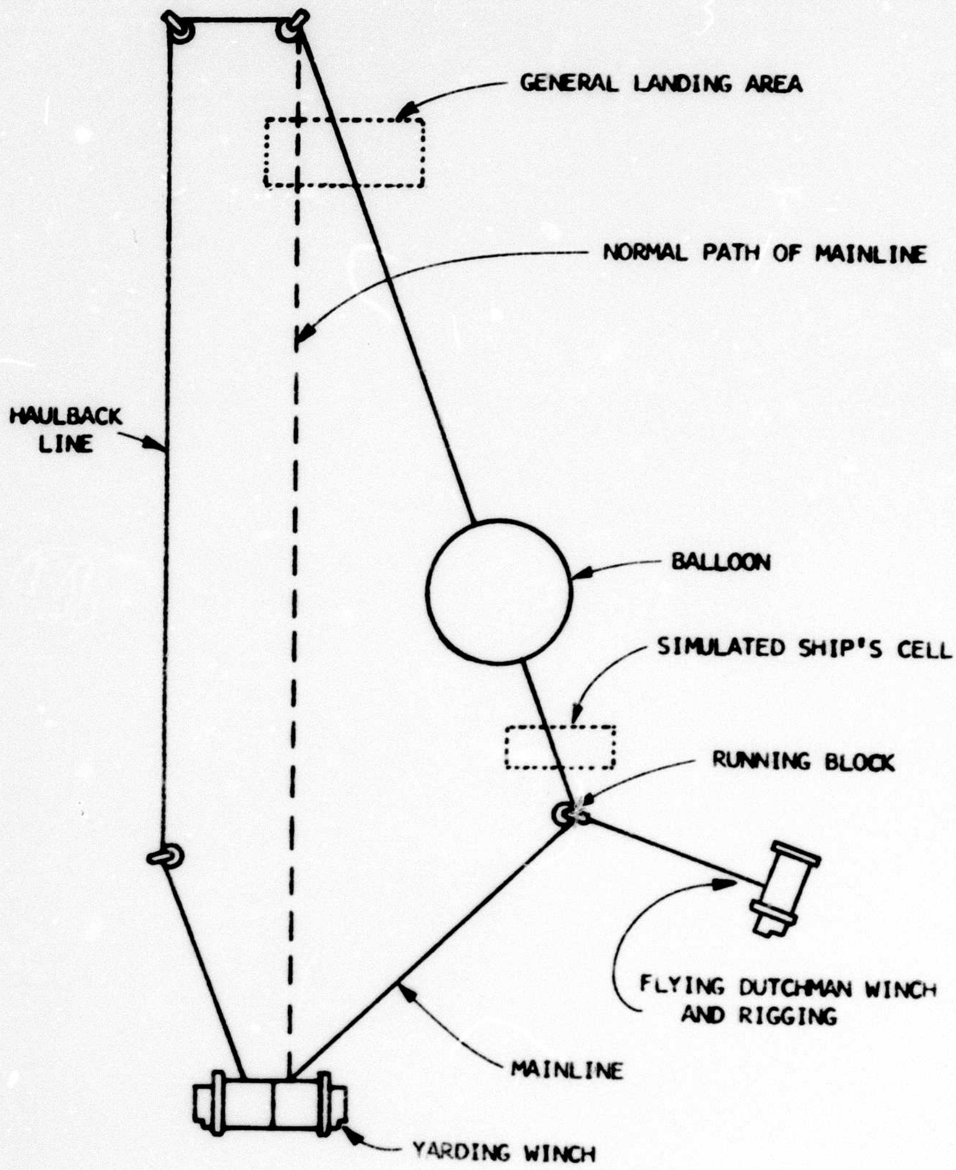


Figure 8 Normal Rigging Configuration

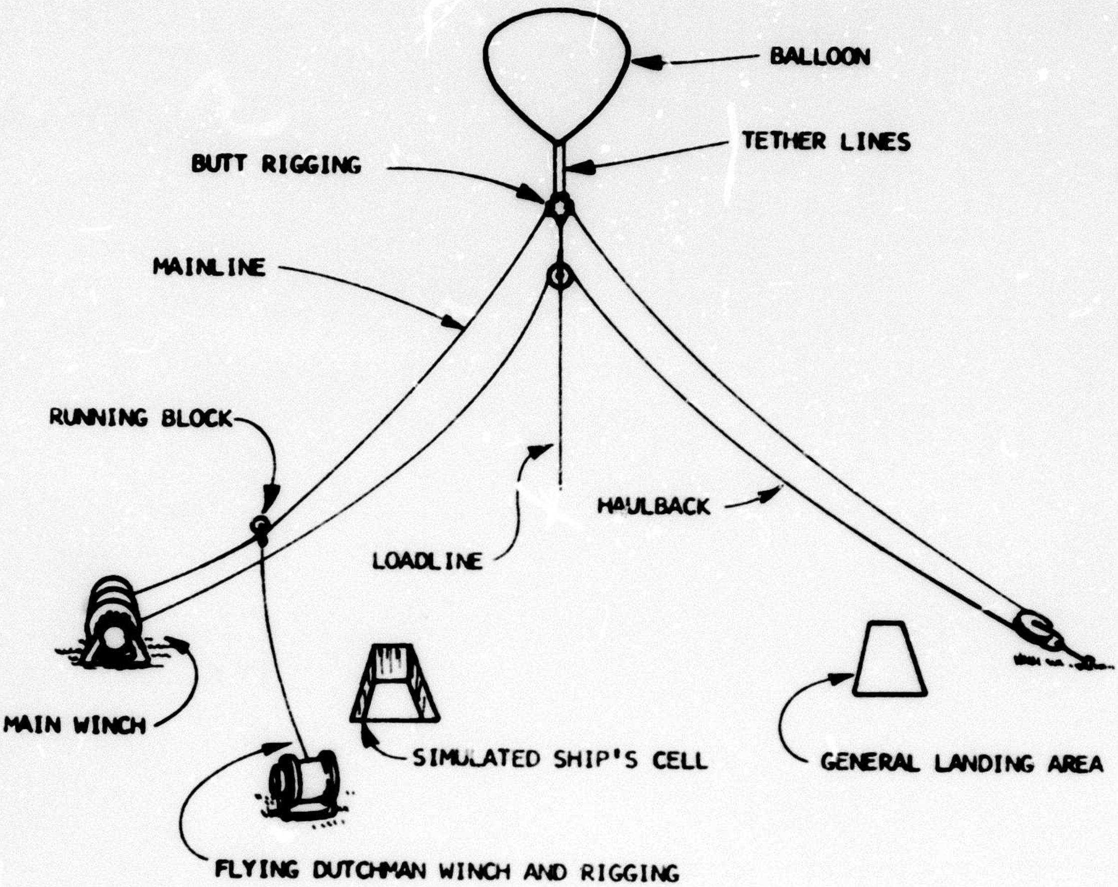


Figure 9 Skyline Rigging Configuration

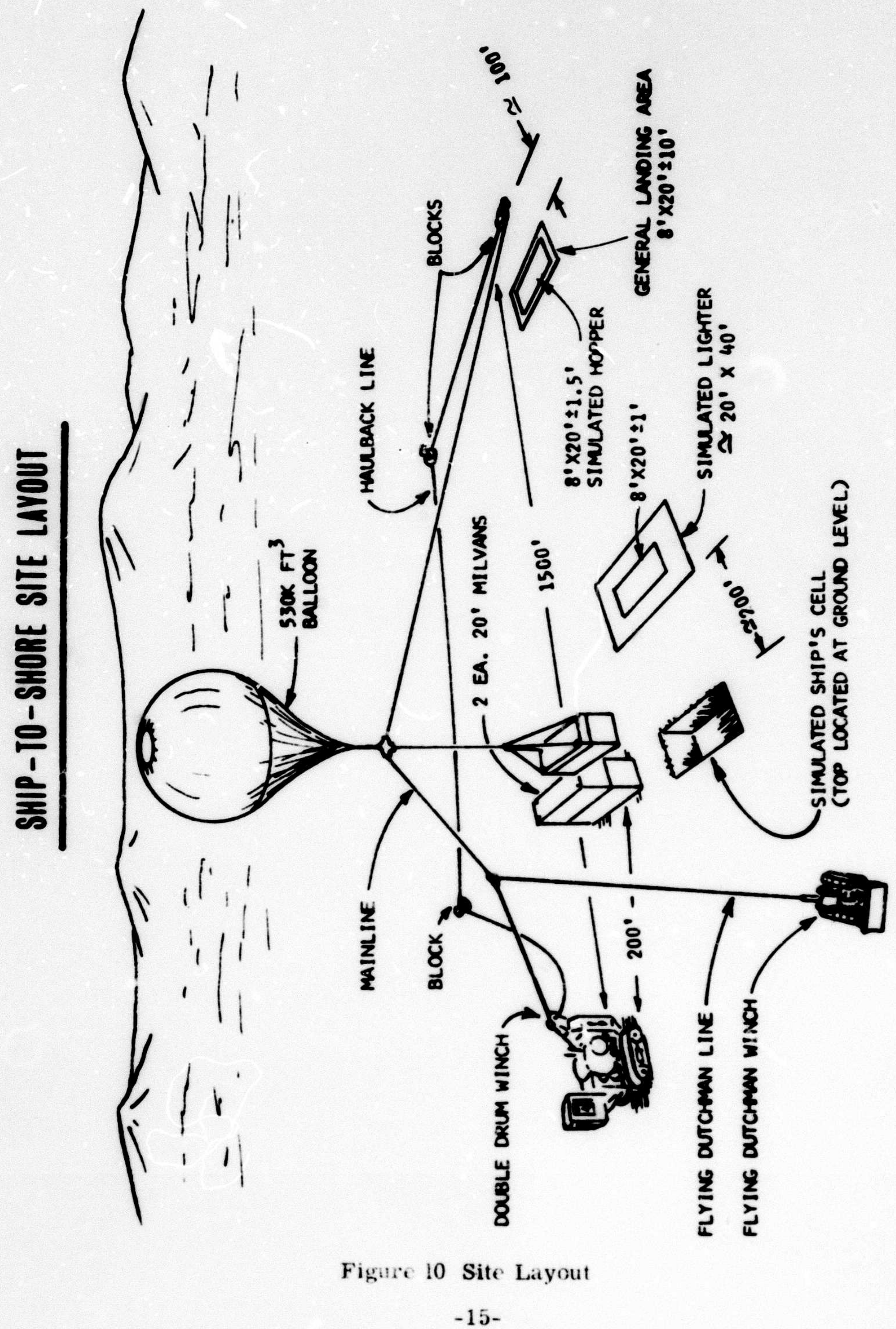


Figure 10 Site Layout

An instrumentation package, provided by RML for installation at the base fitting of the balloon, incorporated self-contained batteries for power and a transmitter for telemetering the data to the ground receiving/recording station shown in Figure 7. Parameters measured and recorded were as follows:

- Balloon Tether Cable Tension
- Balloon Tether Cable Angle (2 axis)
- Wind Velocity
- Temperature

8. System Cable Configuration

Two basic cable configurations were evaluated, the conventional system, depicted in Figure 8, and the skyline system, depicted in Figure 9. Basic differences in the two configurations are that with the conventional system the haulback cable runs on the ground in its return from the tail blocks while with skyline system, the haulback line is supported in the air by blocks attached to the mainline.

The Flying Dutchman rigging was used with both configurations at the yarder end of the system and for one series tests with the conventional rigging, the Flying Dutchman was positioned at the tail block end of the cable configuration.

During operations the balloon is tethered on two 7/8 inch diameter steel cables that are 250 feet long. The tether cables attach at a confluence point, referred to as the butt rigging, to which the ends of the mainline and haulback line are attached as well as the load line. During the tests, the length of the load line going from the confluence point to the container was varied from 222 feet to 122 feet.

The conventional rigging system, while acceptable in logging operations has limitations in over the beach operations where the return cable would tend to be in the way and create safety and maneuvering problems.

C. Site Layout

The site layout was generally as shown in Figure 10. The simulated container cell was secured to two logs, weighing approximately 6,000 pounds each, and placed in an excavation in the ground. The excavation was approximately 80 feet off-center from the normal path of mainline cable. Additionally, the area of the excavation was greater than the cell, as shown in Figure 4, and access to the edge of the cell was limited. It is anticipated that, with a line haul distance of 5,000 - 6,000 feet, the pickup point could be ± 250 feet or more from the normal path of the main line cable.

Buildings and trees within the immediate vicinity of the operations area limited the displacement of the cell to 80 feet from the normal path of the main line. Trees at the landing area prevented the yarder operator from visually observing the operations at that end of the site. Voice radio communications were used to direct these operations. Landing sites at the general landing area and the simulated lighter location were designated by securing colored marking tape to the ground.

V TEST RESULTS

A. Operational Performance

Tests with the conventional and the skyline rigging configurations were conducted over the first three days of the operations. The handling of the spreader bar, its insertion into the simulated cell, and the transport of the containers was accomplished in the three transport scenerios as planned. The Flying Dutchman rigging was successfully used to provide a lateral positioning capability to the cable configuration.

Attachment of the spreader bar to the MILVAN and its extraction from the cell was accomplished with a minimum of problems. The winch operator became proficient in his handling of the system after a short initial learning period. Placement of the containers in the general landing area 1500' away was guided by voice radio while placement of the containers in the lighterage was accomplished under visual control of the winch operator. With the aid of the tag line handlers the containers were placed within the accuracy limits specified for each of the scenerios; Scenerio 1 - ± 10 feet, Scenerio 2 - ± 1.5 feet, Scenerio 3 - ± 1 foot.

B. Performance Timing

The cycle times for ten Scenerio 1 operations ranged from 3 minutes 57 seconds to 8 minutes with an average time of 6 minutes 5 seconds. The cycle times for seven Scenerio 2 operations ranged from 4 minutes 20 seconds to 7 minutes 15 seconds with an average time of 5 minutes 53 seconds. The cycle times for eight Scenerio 3 operations ranged from 2 minutes 52 seconds to 4 minutes 30 seconds with an average time of 3 minutes 44 seconds. These results are well within expected values.

Retrograde operations, though not a requirement for this test series, were conducted and timed. A total of 19 retrograde cycles were conducted. The cycle times ranged from 1 minute 30 seconds to 14 minutes 15 seconds. Considerable time was required to attach the spreader bar to the MILVAN during retrograde operations because the spreader bar lacked guides to aid in positioning it over the MILVAN.

Guides were fabricated and used during the third day of operations and their use greatly reduced the time required for attachment to the MILVAN.

C. Force Measurements

1. With the normal rigging configuration the forces on the main line and haul back lines were generally below 25,000 pounds with speeds up to 1500 FPM. With the skyline configuration the forces on these lines were generally one-third less. The lift of the balloon varied from 21,000 to 23,000 pounds.

2. The maximum forces in the flying dutchman line was 25,000 pounds. This maximum reading was obtained when the main line was pulled over the cell for a container extraction or insertion.

3. The simulated cell altitude was varied in pitch by 5° and in roll by 5.7° to simulate containship motion. The center of gravity of the MILVAN was varied from 8 to 17%. The frictional forces during extraction of the MILVAN varied from 2,000 to 6,000 pounds but the winch operator was able to successfully accomplish the extractions. These test conditions are considered to be worse than would be encountered in an operational situation.

D. Aerodynamic Evaluation

High altitude flights were conducted in order to obtain data that would enable the coefficients of drag and lift to be determined. An analysis of the data obtained will be presented in the final report.

VI CONCLUSIONS

A. Status of the Balloon Transport System

Test results from the Oregon Series II Field Tests indicate substantial potential for the Balloon Transport System in a ship to shore cargo transport mode. This system could be used for ship to shore transport as an aerial tramway, ship to lighterage as an extension of ships gear, and lighterage to shore movement.

1. Operational Check:

During an evaluation of the individual operational steps of the Balloon Transport System it was clearly demonstrated that:

a. A balloon load line can be positioned over a wide range of container stack positions using the "Flying Dutchman" line for lateral control in combination with the main line/ haul back line for fore and aft control.

This range can be expanded to cover all stack positions on a containership by appropriate selection of line and winch parameters. The lateral movement would cover a distance of approximately 400 to 500 feet when discharging a ship 5000 feet from the beach.

b. A spreader bar can be inserted rapidly into a containship cell with minor manual assistance from the deck crew. The spreader bar toggles fall easily into the mating receptacles on the container and connection can be quickly accomplished.

c. A balloon/cable/spreader bar can extract containers from a simulated containership cell over a wide variety of conditions including:

1. Container Layer: Containers were extracted during the tests from cell depths corresponding to the second layer. No problems are anticipated in extracting down to the sixth layer.

2. Pitch and Roll: Containers were extracted from cells adjusted to angles of 5° pitch and 5.7° roll.

3. Center of Gravity Offset: Containers whose C.G. were offset more than 10% from the center line were extracted.

d. A balloon and container can be moved both laterally and up steep slopes with distances limited only by the length of the available cable.

e. A container can be positioned rapidly into a general area on shore (few seconds) and with a slightly greater time penalty into a 1-1/2 foot hopper size space using only radio communication to the winch operator.

f. The returning haul back line as well as the main line can be held out of the water in the region near the balloon by a running skyline rigging. This procedure together with the Flying Dutchman provides a clear area for ships maneuvering in preparation for unloading.

g. The only operational problem encountered was a pendulation of the container during retrograde landing operations on the ship. However as the primary objective of the transport is off loading over the shore, this problem is no objection to conceptual use of the system.

2. System Performance

The performance of the Balloon Transport System is well within striking distance of desired goals.

Since the factors influencing performance are strongly inter-related, tradeoffs between goals are required.

a) Desired performance goals:

Discharge rate: 1 container per 5 minutes

Offshore Distance: up to 1 mile

Accuracy of Deposition: $\pm$ 1.5 ft. for lighter or hopper
$\pm$ 10 ft. for general beach

b) Measured Performance:

1. For discharge to a lighter having an offshore distance capability of 0.5 to 50 miles, measured cycle time was 3 to 4-1/2 minutes.

2. For discharge to a general beach area or to hopper 1500 ft. distant, the measured cycle time was 4 to 8 minutes. The pick up and deposition times at the ends of the transport distance however occupied 2 to 6 minutes leaving approximately 2 minutes for container movement and return of the balloon.

Measured time to discharge to a hopper was not appreciably greater than to a general beach area. The depositing crew appeared to be attempting to place the containers in the general beach area with too close accuracy and unduly penalized the general beach discharge time.

c) Estimated longer range performance:

Extrapolating the 1500 ft. range data to a one mile offshore condition, a single balloon would require 7 to 8 minutes per cycle using pre-slung containers. Two balloons working on either side of a ship could accomplish the discharge within the desired performance goals. Conceptually still longer offshore distances could be handled within the desired discharge rate using multiple balloons operating in parallel or possibly series fashion.

Thus discharge to a lighter satisfies the specified performance goals with emphasis on rapid discharge of the containership. However lighters would be required and transition of the surf and beach must be separately accomplished.

For reasons of economy and reduced dependence on lighterage, it would be desirable to transport the containers completely to shore by the balloon system. This would necessitate either an increase in the allowable cycle time or the use of multiple balloon systems.

B. Status of the Components

1. Balloon

The design of the balloon is generally very good, production methods have been developed, and operation is well understood. Improvements could be made for higher wind conditions and higher traverse velocities. Anticipated cost for lift of 23-25 tons = $150/$175,000.

2. Winch

While the double winch used in the tests illustrated excellent control capabilities, greater power is required for horizontal motion, for larger load capabilities and for higher velocity operations. The self-propelled yarder should be redesigned to be air transportable, to be able to get ashore quickly and easily, and to provide a range of 5000 to 6000 feet. Anticipated cost = $300,000 - $550,000.

3. Cable, Blocks, and Anchors

The cable, blocks, and rigging for the Flying Dutchman, and Running Skyline were quite satisfactory. Rigging methods for multiple balloon operations should be further investigated. Anchors and buoys for offshore blocks must be examined further.

Anticipated costs including D-8/9 type caterpillar tractor with high speed winch = \$150,000 - \$200,000.

C. Anticipated System Costs

1. First Unit 23-25 ton lift for 5000 - 6000 ft. transport = \$800,000
2. Additional units = \$700,000

Above figures include \$50,000 for helium but does not include helium transport trailers.

APPENDIX I - DETAILED TEST RESULTS

A. Day 1 and Day 2

With the rigging arrangement and the site layout as depicted in Figures 8 and 10, the following timing data was obtained. Figure 11 shows the rigging, balloon and a MILVAN in flight.

1. Scenario 1 - Simulates a ship to shore unloading operation over a distance of 1,500 feet with a broad placement latitude on the beach (± 10 feet).

Number of Cycles	Spread of the Cycle Times
6	3 min 57 sec to 8 min

2. Scenario 2 - Simulates a ship to shore unloading operation over a distance of 1,500 feet with a placement accuracy of ± 1.5 feet corresponding to depositing a container in a hopper.

Number of Cycles	Spread of the Cycle Times
5	4 min 50 sec to 7 min 15 sec

Figure 11 Conventional Rigging with MILVAN

Discussion (Scenario 1 and 2)

Attachment of the spreader bar to the MILVAN and its extraction from the cell was accomplished with a minimum of problems. Tag lines, attached to each corner of the spreader bar, were utilized to aid in attaching the spreader bar. Extraction of the container was a simple, smooth operation. The landing zone was obscured from the view of the winch operator by a line of trees. Voice radio was used to guide the operator in placing the container into the designated area. Positioning of the containers within the accuracy requirements was accomplished by tag line handlers.

3. Scenario 3 - Simulates a ship to lighterage unloading operation over a distance of approximately 100 feet with a placement accuracy of ± 1 foot.

Number of Cycles	Spread of the Cycle Times
5	3 min 14 sec to 4 min 30 sec

Discussion:

Attachment of the spreader bar and removal of the containers was accomplished as in Scerarios 1 and 2. A designated area near the cell was used to simulate a lighter. Placement of the container within the accuracy limits specified (± 1 foot) was aided by tag line handlers.

4. Retrograde Operations

Scenarios 1 and 2 - Simulated a shore to ship return of MILVANS over a distance of 1,500 feet.

Number of Cycles	Spread of the Cycle Times
7	3 min 43 sec to 14 min 15 sec

Scenario 3 - Simulated a lighter to ship return of MILVANS over a distance of 100 feet.

Number of Cycles	Spread of the Cycle Times
3	3 min 23 sec to 6 min 34 sec

Discussion

While not normally required in over the beach operations the retrograde capability was tested as loading of the cell was required prior to "off loading" operations. The major problem areas during these retrograde operations were as follows:

a. In the initial retrograde tests the spreader bar was quite difficult to attach to the container located in the landing area with only radio communications to direct the positioning of the spreader bar above the container. The spreader bar did not have guides to aid in positioning the locks into the container holes on the top of the container, necessitating considerable jockeying to get the proper alignment. The spreader bar was later modified by the addition of guides. A discussion of this improvement follows later in this report.

b. Inserting of the container into the cell was hampered by two factors. One, the pendulous action of the container was pronounced, varying from 50 feet during the early retrograde cycles to 5 feet to 10 feet as the operator became more proficient. This motion control was accomplished by closely controlling the rate of deceleration of the balloon system as it returned to the cell area. Final damping of the pendulous action was obtained by placing the container on the cell. The tag line handlers then were able to assist in inserting the MILVAN into the cell. Two, the large excavation around the cell impeded the efficient use of tag line assistance. The tag line handlers had to exercise caution while working around the cell during retrograde.

5. Force Measurements

a. Special tension and speed measurement equipment was utilized to obtain data on the main and haulback lines. The forces on these cables were generally below 25,000 pounds with speeds up to 1,500 fpm. Telemetered data from a load cell in the balloon tether line indicated a balloon lift of 21,000 to 23,000 pounds depending on super-heat conditions, e.g., under cold cloudy conditions the lift was 21,000 pounds; with a bright sun the lift increased to 23,000 pounds. With larger balloons having 50,000 pound lift capabilities the net lift under cold cloudy conditions would be on the order of 45,000 pounds.

b. Hardwire data from a load cell in the Flying Dutchman line indicated a maximum tension of 25,000 pounds. This maximum reading was recorded at that point in which the mainline was pulled from its normal path to a position over the cell for a container extraction or insertion.

c. A series of tests were conducted in order to determine the load force associated with the extraction of a MILVAN from the cell. The cell attitude was varied in pitch and roll in an attempt to simulate containship motion. Hardware data from a load cell in the load line was recorded inaddition to main, haulback and Flying Dutchman force measurements. The position of each element and geometry of the cable arangement was determined to enable calculation of the cable forces for comparison with experimental results. Weights were placed in one end of the MILVAN to obtain a center of gravity offsets. Regardless of cell or container attitude the additional extraction loads were approximately 2,000 pounds except for one deliberate hangup, case 3 with the CG offset towards the rear of the cell, in which the frictional loads went to 6,000 pounds. These frictional forces posed no extraction problems and the container was easily removed and inserted into the cell.

Case 1:

Cell Pitch - 1.7°

Cell Roll - .8°

Load 495# = CG offset of 8.7%

Five extractions with CG offset towards the front of the cell and two extractions with the CG offset towards the rear of the cell.

Case 2:

Cell Pitch - 1.7°

Cell Roll - .8°

Load 990# = CG offset of 17.4%

Five extractions with the CG offset towards the front of the cell and five extractions with the CG offset towards the rear of the cell.

Case 3:

Pitch - 5°

Roll - .8°

Load 990# = CG offset of 17.4%

Five extractions with the CG offset towards the front of the cell and five extractions with the CG offset towards the rear of the cell.

Case 4:

Pitch - 1.5°

Roll - 5.7°

No CG offset

Five extractions

B. Day 3

The rigging configuration was changed to the skyline system as depicted in Figure 9. Each of the scenarios was repeated and timed.

1. Number of Cycles		Cycle Times
Scenario 1	2	4 min 37 sec and 6 min 50 sec
Scenario 2	2	5 min 20 sec and 5 min 50 sec
Scenario 3	2	2 min 52 sec and 3 min 54 sec

2. Retrograde Operations

	Number of Cycles	Cycle Times
Scenario 1	2	5 min 8 sec & 6 min 39 sec
Scenario 2	1	6 min 18 sec
Scenario 3	4	1 min 30 sec 1 min 45 sec 1 min 56 sec 2 min 17 sec

Discussion:

No significant differences were noted during operations with the skyline rigging as compared with the conventional rigging system used on Day 1 and 2. The forces on the main and haulback lines were about 1/3 less than measured with the previous system. The winch operator commented that the system felt "softer", i.e., the response of the system was more sluggish. The Flying Dutchman block was initially attached to the haulback line but because of terrain limitations which prevented adequate movement of the Flying Dutchman caterpillar, the Flying Dutchman was moved to the main-line and successfully utilized.

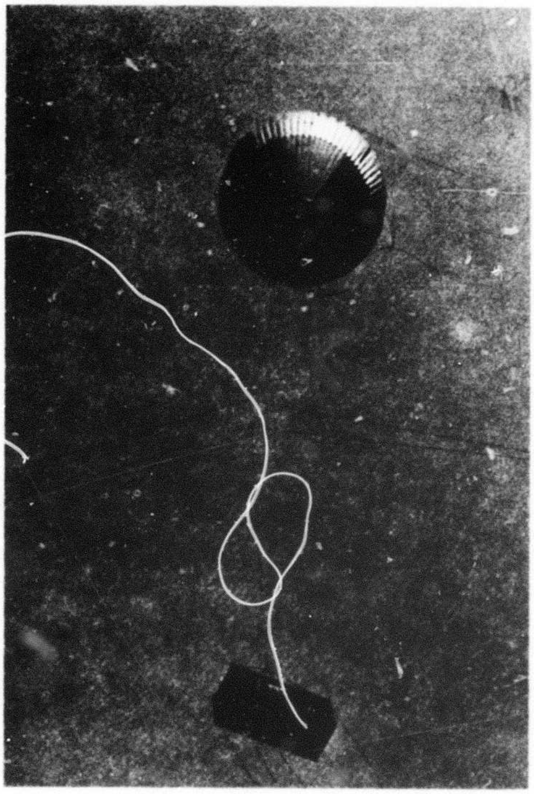


Figure 11 Slyline Rigging with MILVAN

DISCUSSION

The spreader bar was modified by the addition of standard guides not included with the furnished spreader bar to allow faster and easier attachment to the MILVAN.

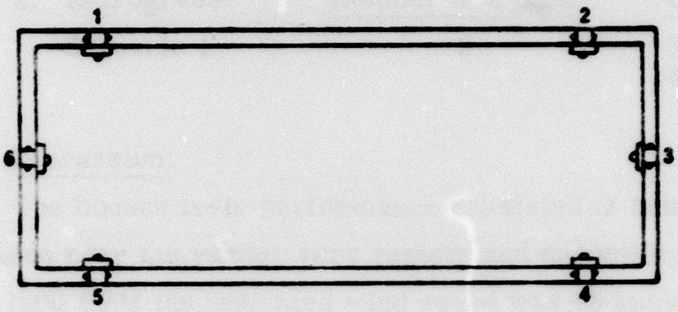


Figure 12 Spreader Bar Guide Position

Tests were run with all six guides in position and with guides 1, 2 and 6 in the up position. It was found that the best operating mode was with all the guides in the active position. As stated previously, one of the difficult problems with the spreader bar was its positioning and attachment to the MILVAN during retrograde operations. Without modifications, the average time for attachment to the MILVAN in the landing area was two minutes and 4[illegible] seconds for nine operations. With the modifications described above, the average time was 42 seconds for 12 operations.

C. Day 4

The rigging configuration for this day's operation was changed back to the conventional system used on Days 1 and 2. A series of speed runs and bounce tests were conducted to gather data on the balloon system as it operated with heavy weights (17,000# logs). In addition, several cycles were run utilizing slings instead of the spreader bar, and high altitude flights were conducted to gather aerodynamic data on the natural shaped balloon.

1.	Number of Cycles	Cycle Time
Scenario 1	1	4 min 58 sec
Scenario 3	1	4 min 20 sec

2. Retrograde:	Number of Cycles	Cycle Time
Scenario 1	2	3 min 31 sec 4 min 7 sec

Discussion:

The bounce tests performance consisted of bringing the heavy log into the area near the yarder very rapidly and depositing the log quickly. At speeds of 1500 FPM the indicated wind speed was 48 knots with the tether load at 29,000 lbs.

As a second part of these bounce tests the balloon was pulled down close to the ground and then quickly released to impact a jerk on the log being used as a load. Tether tension was recorded at greater than 60K pounds.

The operations conducted with slings instead of the spreader bar were similar to the tests conducted in Oct 1972 during the first test series at Culp Creek, Oregon, in that the containers were pre-slung and the ease and speed of transporting MILVAN's in this configuration was evaluated. This mode of operation is similar to the logging operation, i.e., the logs are pre-wrapped with a steel line and are quickly attached to the dangling load line and moved away.

Altitude flights were conducted during the afternoon of Day 4. The figure below depicts the configuration of the system during this portion of the testing.

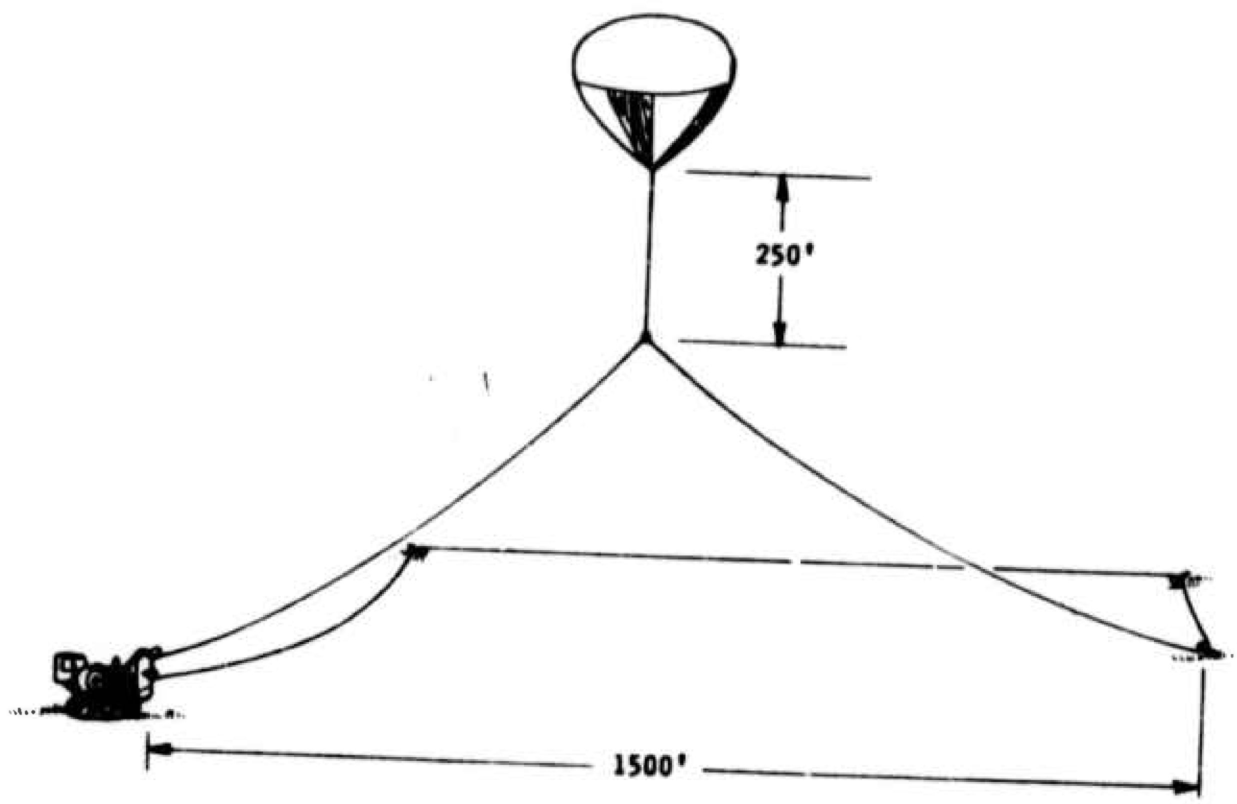


Figure 13 Altitude Test Configuration

PERTINENT DATA

Temperature - 12°C

Barometric Pressure - 30.03"

Winds - Approximately 8 knots at 330°

Balloon inflated to 90% of its capacity of 530,000 cu ft

Altitudes:

2750' above sea level

3400' " " "

2660' " " "

An evaluation of the data gathered from these tests will be presented in the final report.

D. Day 5

The cell was moved from the area near the yarder and placed in the general landing area approximately 1500' away as shown in Figure 14. This test was performed to simulate the configuration of unloading of a containship with the yarder on the bench.

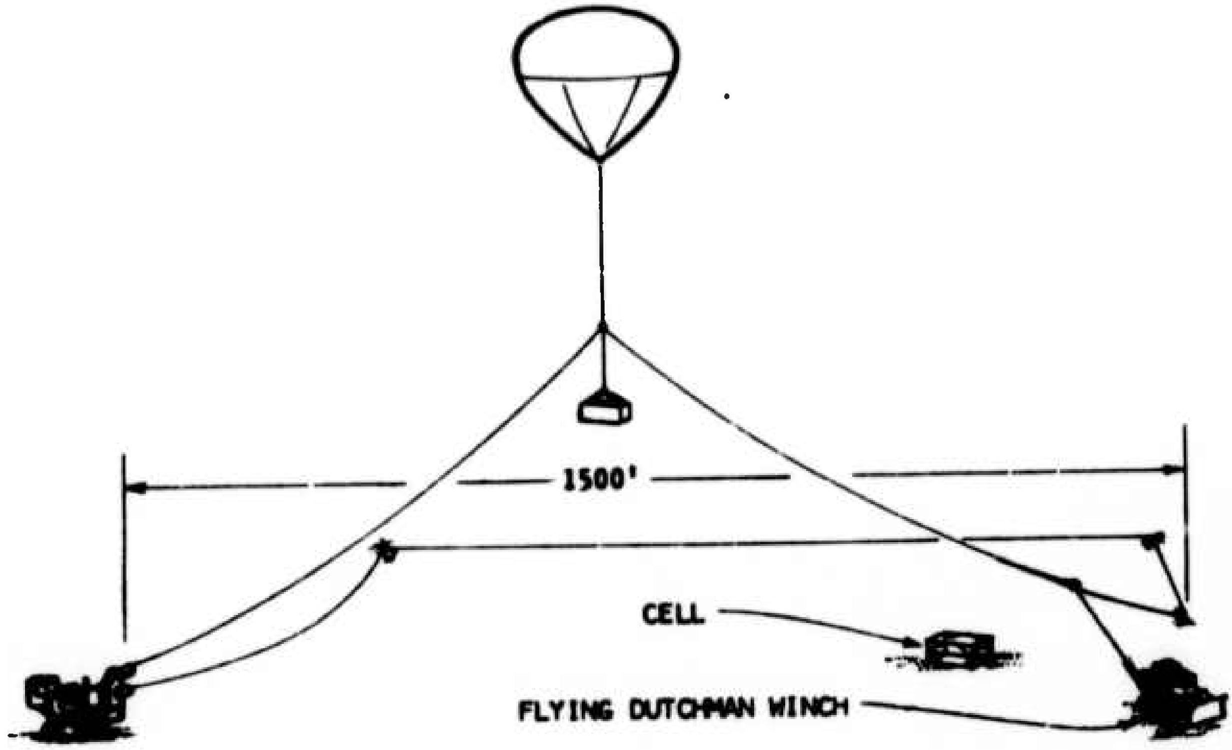


Figure 14 - Configuration ·· ·ed to Simulate Unloading of a Container with the yarder winch on the beach

Discussion:

MILVAN's were successfully inserted into the cell and extracted from the cell utilizing the spreader bar, tag line handlers and the Flying Dutchman winch. Heavy rains and a predicted storm front forced curtailment of extended evaluation of this mode of operation but based on the limited data the general statement that such a mode of operating could be feasible is warranted.